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An
inaugural dissertation
on
the effects of Cold:
for
the degree, Sapd March 2 1829
of
Doctor of Medicine,
in the
University of Pennsylvania,

by

Michael D. Donnellan,
of
North Carolina.

Philadelphia
November 26th 1828.

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Effects of Cold.

Cold I maintain to be directly sedative, in its primary operation in every instance, & indirectly stimulant, when the application of it is not continued too long, & the system to which it is applied is capable of reaction. "Ubi stimulus vel irritatio ibi affluxus" is an aphorism of the Father of Medicine, the correctness of which has not, so far I know, been denied or disputed by any one, since his time, down to the present day. Hence I argue, that whatever causes a reflux, or recession of the blood, from the part or parts to which it may be applied, is not a stimulus. In order to argue more methodically & logically, I shall put my argument into the form of a syllogism. Whatever causes a reflux is not a stimulus;

whatever causes action in a part, is a Stimulus

But Cold causes a reflex – or action different
from the pre existing

Therefore, Cold is a Stimulant –

But cold causes a reflux;

Therefore Cold is not a stimulus.

Thus I prove the major proposition. Every stimulus chemical, mechanical, or specific produces an afflux of blood to the part, to which it is applied. Heat, blisters, sinapisms &c. all produce this effect. Therefore, whatever does not produce an afflux of blood to the part to which it is applied, is not a stimulus. Therefore, whatever produces an effect diametrically the opposite of afflux is not a stimulus. But reflux is diametrically the opposite of afflux: therefore whatever produces a reflux is not a stimulus. Thus I prove the minor proposition. Cold is so universally acknowledged to be a repellent, that it would be wholly superfluous to adduce any arguments in proof of it.

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Surgeons have been, from time immemorial, in the habit of applying cold substances to inflamed parts; both to diminish the heat of the parts, & to cause a reflux, or recession of the blood from them. When a person goes into a cold bath, the surface becomes pale, & why? Because a reflux has taken place from the capillaries. Therefore Cold causes a reflux; & ergo Cold is not a stimulus.

Cold in the language of Philosophy is but the absence of heat; & why that, which instantaneously, & therefore primarily causes an absence, or diminution of what is acknowledged on all hands, as the natural & universal stimulus, should itself be called or considered a direct stimulus, I cannot conceive. Cold, by whatever medium it may be applied, whether

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by water, or air, invariably produces a diminution of heat commensurate with its degree: i.e. the greater the cold, the greater the diminution of heat. When a hot & cold substance are brought in contact, the heat passes from the former to the latter, until the temperature of both is the same: thus hot & cold substances, when in contact, ever tend to effect an equilibrium, or an equality of temperature. So it is, when cold water, or air is applied to the human body; the heat passes from the latter to the former, & continues so to pass, until the heat, at the surface of the body, is at length reduced to an equilibrium in point of temperature with the air, or water applied, which of course undergoes a corresponding elevation. If A enter a bath of 40° Fah. & B go into one of 50°,

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provided that the bodies of both be, at the time, of the natural standard 98°, A's body will be reduced, at the surface, to 69°; & B's to 74°: A having lost 29 & B 24° Fah. Now that which, when applied to the body, invariably takes away, ipso facto, a part of its stimulus, not secondarily & indirectly, but primarily & directly, ought not itself to be considered a direct stimulus; but cold, when applied to the human body, invariably takes away, by its primary & direct operation a part of its stimulus - Ergo cold ought not itself to be considered a direct stimulus. What then is cold if it be not a stimulus? I know nothing that, in its primary operation, has a stronger claim to the appellation of sedative. It invariably diminishes, at the moment of its application, the natural stimulus of the

a relative term only

body; & causes a movement in the blood, diametrically the reverse of that produced by all known stimuli. Therefore, it must be something, which, in its primary operation at least, is diametrically opposite to every known stimulus; & that is a sedative.

Another proof that cold is not a direct stimulus is, that it never produces inflammation per se. Baron Larrey tells us in his memoirs, that the soldiers in the French army, during the retreat from Moscow, experienced no ill effects from the most intense cold, though exposed to it many days, until a thaw supervened. Cold then requires the intervention of heat, before inflammation is produced by it. Heat itself, & all the stimuli with which we are acquainted produce inflammation per se, without the intervention of any other agent. Therefore cold differs, in this respect also,

+ would an equal amount of tepid water produce an equal effect – doubtful.

from all known stimuli. It is not the proximate, nor is it the occasional or exciting, it is merely the predisposing cause of inflammation.

The effects produced by the medium, through which cold is applied, are mistaken I believe in many instances, for the effects of cold itself. If a bucket of cold water be thrown upon a patient in syncope, it will operate as a stimulus, & resuscitate the patient. But cold, a mere negative quality, & simply the absence of heat in the water, does not certainly, under such circumstances, stimulate the patient. No, it is the water itself, which, by the gravity of its globular particles, produces a stimulant impression on the nerves of the patient. The atmospheric fluid will, also, when it strikes the surface forcibly on a cold windy morning, produce a stimulant impression, on the nervous system, independent of the seda-

tive effect produced by the cold in it; or rather by the absence of heat in it.

But it will be perhaps asked, if I admit that the water itself, abstracting from its temperature, produces a stimulant impression, how reconcile this to the sedative & sanative effects, which I shall hereafter advert to, as produced by cold water, in Typhus & other fevers? I answer, that the stimulant impression of the water itself, when applied for a certain length of time, is more than counterbalanced by the abstraction & loss of the stimulus heat; & thus eventually, a full & entire sedative effect is obtained, to the great relief & benefit of the patient.

Baron Larrey, who witnessed the effects of cold in various degrees, in different stages, & on different constitutions, during the retreat of the French from Moscow, considers cold, if I understand him aright, as a direct sedative. "Cold" says the Baron in

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his memoirs, "acts on the living parts by blunting the sensibility of those organs, which are subjected to its immediate impression: the natural heat is absorbed, & a discharge & repercussion of caloric takes place - the pores are closed: the fibres & capillary vessels fall into a state of contraction: the fluids are condensed & flow more slowly. At first, the action of the cold is painful: the skin wrinkles & loses its natural colour. Yet the animal heat & the vital powers resist this sedative & contracting power, that opposes the return of the fluids: the capillary system is obstructed more easily, when its extreme ramifications are weakened. The skin becomes red, its sensibility is blunted, & if the effects of the cold continue, it gradually becomes extinguished & torpor soon takes place."

In the very interesting case of torpor from cold related by Dr. Kellie, in the 1st. vol. of the Edinburgh Medical & Surgical Journal, we find

some excellent remarks, by that gentleman, on the effects of cold, which he certainly believes to be a direct sedative. "Of the general exciting or stimulant power of heat" observes the Dr, "there can be no doubt. And with regard to cold, the disputes concerning its operation have been perpetuated by logical illusion only". Afterwards he proceeds thus - "Within the limits of each appropriate range of temperature, the life & active vigour of the being is maintained. As the temperature descends, it stimulates less & less, till it reaches at length a point at which it ceases altogether to have any effect. On the other hand, the temperature carried too high for the powers of the system, debilitates the individual, & destroys action, which may be again restored by reducing the temperature; & thus the abstraction of caloric invigorates & produces excitement. In this way, the stimulant power of heat, the sedative operation of cold,

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& what has been called its tonic power are true in fact, & mutually reconcileable. The energies of organised beings are not constant but fluent quantities; the kind & degree of heat, therefore, which results from the operation of an external agent, will be as those energies, & the powers of the agent conjointly, both of which are variable. To apply these general observations to the influence of cold, or diminished temperature on the human system, we remark that, by these alone the great variety of changes produced can be reconciled or explained. A certain decrease of temperature, which invigorates some, to which many acknowledge an increase of spirits, health, & activity, depresses others, & induces lassitude, rigor, dyspepsia, headache, catarrh: from greater changes arise rheumatism, pneumonia, the other phlegmasia, & fever itself, according to the various predisposition of individuals. In all, the general

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application of great or long continued cold produces languor, lassitude, faintness, debility of the voluntary powers, drowsiness, torpor & death?

I believe then, that cold acts as a sedative primarily & directly, by suddenly abstracting a part of their stimulus, (heat) from the extreme ramifications of the capillary system; whereby not only these ramifications, but the whole capillary & arterial systems, & even the heart itself are weakened more or less, according to the greater or less intensity of the cold applied.

In that chaste & elegant writer Quintus Curtius, we find a memorable instance of the debilitating & dangerous effects of cold, suddenly applied to an overheated & exhausted frame. Alexander had performed forced marches, for many days, in order to anticipate the Persians in taking possession of the city of Tarsus.

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Exhausted by long continued toil & fatigue, & covered with dust & sweat, the conqueror entering the city, at the head of his troops, stripped himself in sight of his army, & plunged headlong into the cold waters of the Cydnus, which ran through the city. The immediate consequences are thus finely described by his biographer — "Vixque ingressi subito horrore artus rigere cœperunt: pallor deinde suffusus est, & totum propemodum corpus vitalis calor reliquit. Expirantis similem ministri manu excipiunt, nec satis compotem mentis in tabernaculum deferunt."

Currie who believes in the direct stimulant power of cold, quotes this passage in his reports, & observes that he rests no part of his conclusions upon it. It is, however, sufficiently well authenticated; but the fact is, the effects of cold described in the passage just quoted, are wholly irreconcilable with Dr. Currie's doctrine.

+ The Russians plunge into Cold water or Snow immediately from the hot bath, whilst copious by sweating —

Alexander having lost much of the stimulus of heat, by the copious perspiration that flowed from him during his march, stood in need of a stimulant, at the time he plunged into the Cydnus. A stimulus, (according to that gentleman) & a direct one too, was afforded him in the cold water; but the conqueror of the world was never before so near death. The consequences would have been still more dangerous, & perhaps fatal, had he taken a copious draught of the water into the stomach: not so tho, had he swallowed some wine, brandy, or any other stimulant beverage.

The practice of drinking cold water, at a time when the system is much heated, & particularly, when it is debilitated & exhausted by long continued exertion, toil, & fatigue, is sometimes fatal, & always dangerous. The symptoms of dangerous cases are thus described by Dr. Rush. "A few

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minutes after the person has swallowed the water, he is affected with a dimness of sight; he staggers in attempting to walk, & unless supported, falls to the ground; he breathes with difficulty; a rattling noise is heard in his throat; his nostrils & cheeks expand & contract in every act of respiration; his face appears suffused with blood, & of a livid colour; his extremities become cold, & his pulse imperceptible; & unless relief be speedily obtained, the disorder terminates fatally in four or five minutes".

"I know" says the Doctor, "but of one certain remedy for this disease, & that is liquid laudanum. The doses of it, as in other cases of spasm, should be proportioned to the violence of the disease. From a tea-spoonful to near a table-spoonful has been given, in some instances, before relief has been obtained. When the powers of life appear to have been suddenly suspended, the same

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remedies should be used, which have been so successfully employed in recovering persons supposed to be dead from drowning".

Cold has been found to be very beneficial in Typhus & other fevers: it has likewise afforded not a little relief, (if the reports of Currie be correct,) in those two horrible & appaling diseases, Tetanus & Epilepsy. The modus operandi of cold, in Fever, is very intelligible, & quite satisfactorily explicable, on the principles which I have been advocating. In Fever there is too great an evolution of caloric, which being a stimulus directly & per se, the pulsations of the heart & arteries are increased in frequency, in proportion as the stimulus is increased. If cold water be applied to the surface, under such circumstances, an absorption & repercussion of caloric takes place; the action of the whole capillary system, of the arterial system, & that of the

Before the word reaction, on the opposite page, in the second line, immediate or speedy has been accidentally omitted. It was intended to be, beyond the point of immediate or speedy reaction

heart itself is diminished: this process being kept up or continued beyond the point of reaction, the action of the heart & arteries becomes more natural, viz. diminished in frequency, but increased in fulness - & thus the excessive stimulus of the system being reduced by the counteracting & sedative influence of cold, the patient experiences very great relief. The patient is here relieved by cold, in a manner very similar to that, in which venesection proves so beneficial to a patient, whose system is overwhelmed & prostrated by excessive stimulation; & whose pulse is in that state, to which Dr. Rush gave the name of oppressed pulse.

Cold water may be applied in different ways, viz. by immersion, (which mode is preferred by Currie in Epilepsy & Tetanus) by affusion, or dashing it on the body, by aspersion, or the shower bath, & by sponging. Currie

~~prefered a Gorgian in Fever. Professor Chapman,~~
who when a student of Medicine in Edinburgh
witnessed the fatal effects of this mode of apply
ing it, in many cases of Typhus, in which
there was but a partial or no reaction, prefers
the last mentioned mode. "As a safe mode"
says the professor, "I recommend sponging; &
here the reaction should be slow, & the tem-
perature about 30 or 40° of Fahrenheit. It removes
heat, quiets restlessness, & all the results from
cold water may be had in this way".

Attention should be paid to the state of the
system at the time of using it. "It may be
safely used at any time of the day", says Dr.
Currie, "when there is no sense of chillness
present, when the heat of the surface is stea
dily above what is natural, & when there is
no general or profuse sensible perspiration".
These precautions (though never to be wholly

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lost sight of) are not so necessary, when cold water is used in the safer & equally efficacious manner recommended by Dr. Chapman.

The local effects of cold are divided by Thomson into three species; 1st Into those in which inflammation is excited, but an inflammation which, under proper management, has a tendency to terminate in spontaneous resolution. 2d Into those in which the inflammation excited is followed by the state of vesication, suppuration, or even ulceration. 3d Into those, in which the vitality of greater or less portions of the extreme parts of the body is either immediately destroyed by their congelation, or the same destruction effected afterwards more slowly by gangrene, terminating in sphacelus". These three species he includes under the general appellation of frost bite. Professor Gibson, however, & most other wri-

ters, I believe, on Surgery, treat the two first species or divisions under the name of Pernio, or Chilblain; & the last under the term Frost-bite. The mild form of chilblain is attended with slight redness of the skin, a sensation of heat & itching, which symptoms spontaneously disappear in Summer; but usually return in Winter, attaching the same parts.

This form of Pernio is not unfrequent in temperate & moist climates. When the disease appears in its most violent shape, there is more or less swelling, the skin is redder, but gradually acquires a livid hue. The heat, itching, & pain are excessive; so much so that the patient is unable to use the part. Vesications sooner or later occur; in some instances in a few hours, in others not for a day or two after the exposure. When the vesicles burst a serous fluid is evacuated, producing excoriations, which are soon converted in-

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to ill conditioned sores, penetrating in many instances to the bone. These sores discharge a thin ichorous fluid, are very obstinate, & exceedingly difficult to heal.

Treatment. The milder chilblains may generally be cured by rubbing them with snow, or bathing them in ice water several times a day, keeping the part immersed each time, till the pain & swelling are much abated. This treatment is adapted neither to phthisical, nor arthritical patients; nor is it suited to delicate females. In such cases, the affected parts may be rubbed with spirit of wine, linimentum saponis, tinctura myrrha, or a strong solution of alum, or vinegar. A mixture of oleum terebinthina & balsamum copaiva in equal parts; & another consisting of two parts of camphorated spirit of wine, & one of the aqua litharyyri acetati are said

to be excellent applications. Richter says that the application of electrical sparks to the part affected soon restores its natural warmth. Carded cotton & alum curd are praised by Dr. Gibson, in this form of the complaint. The ulcerated chilblain requires stimulating dressings, such as lint dipped in a mixture of the aqua litharyri acetati, & aqua calcis; in tinctura myrrhæ, or warm vinegar. Solutions of lunar caustic, or of the preparations of lead or lime water, mixed with linseed oil, are often necessary & always highly beneficial.

When the intensity of the cold is such that, that the vitality of a part is suspended, or destroyed, the injury is designated by the term frost-bite. The vitality of a part may be destroyed either immediately or mediately: immediately by the cold, mediately by mortification. The condition of a part whose

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vitality is suspended, not destroyed, resembles that of hybernating animals in the winter season, viz. stiff, devoid of feeling, & completely torpid. The indication here, as in the first stage of all injuries resulting from exposure to cold, is to restore gradually the natural heat of the part. This is accomplished by rubbing the part affected with snow, or immersing it in ice water. No force is to be used in rubbing the part: the gentlest friction only is to be employed. In this way, the natural temperature may, if the surgeon be called in time, be restored, & mortification prevented. When the parts have a tendency to mortify, stimulating embrocations become necessary; but if the inflammation be high, cold applications are required, as a solution of the acetate of lead &c. Mortification having supervened, the usual remedies for it must be employed. But if instead of all this, the

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patient be, in the first place, brought into a warm room, placed before a fire, & stimulating applications be employed, an action is excited in the parts too great for their power, & mortification is the inevitable consequence.

"When the system", says Dr. Gibson in his late work on Surgery, "is affected by cold to such an extent as to render the patient insensible, various means may be used to produce reaction. The chief indications are to excite the muscles of respiration, & to restore the circulation. The former may often be accomplished by sternutatories & volatiles; & the latter by frictions with flannels, covered with stimulating materials, & applied to the whole surface, particularly to the epigastric region. This treatment should be continued, unremittingly, for a considerable time; for instances have occurred of recoveries, after the lapse of several days, & under the

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most unfavourable circumstances. Some writers recommend the immersion of the whole body in ice water; but the practice cannot prove otherwise than injurious, & should never be pursued. After the patient has been somewhat revived, by the means pointed out, it will be proper to administer stimulants internally, such as brandy & water or a little warm wine. Very often it will become necessary to keep up for some time the patient's strength. In such cases the internal use of the sulphate of quinine, or of musk & ammonia combined, will prove exceedingly beneficial."